

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : H01L 33/00</p>	<p>A3</p>	<p>(11) International Publication Number: WO 99/10936 (43) International Publication Date: 4 March 1999 (04.03.99)</p>
<p>(21) International Application Number: PCT/US98/17849 (22) International Filing Date: 28 August 1998 (28.08.98) (30) Priority Data: 08/920,409 29 August 1997 (29.08.97) US (63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application US 08/920,409 (CON) Filed on 29 July 1997 (29.07.97) (71) Applicant (for all designated States except US): CREE RESEARCH, INC. [US/US]; 4600 Silicon Drive, Durham, NC 27703 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): SLATER, David, B., Jr. [US/US]; 6304 Jarratt Cove, Raleigh, NC 27613 (US). NE- GLEY, Gerald, H. [US/US]; 3512 NC 86 S., Hillsborough, NC 27278 (US). EDMOND, John, Adam [US/US]; 206 W. Jules Veme Way, Cary, NC 27511 (US). (74) Agent: SUMMA, Philip; Suite 315, 13777 Ballantyne Corpo- ration Place, Charlotte, NC 28277 (US).</p>		<p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 14 May 1999 (14.05.99)</p>
<p>(54) Title: ROBUST GROUP III NITRIDE LIGHT EMITTING DIODE FOR HIGH RELIABILITY IN STANDARD APPLICATIONS</p>		
<p>(57) Abstract</p> <p>A physically robust light emitting diode is disclosed that offers high-reliability in standard packaging and that will withstand high temperature and high humidity conditions. The diode comprises a Group III nitride heterojunction diode with a p-type Group III nitride contact layer, and ohmic contact to the p-type contact layer, and a passivation layer on the ohmic contact. The diode is characterized in that it will emit at least 50 % of its original optical power and remain substantially unchanged in operating voltage after operating for at least 1000 hours at 10 milliamps in an environment of 85 % relative humidity at a temperature of 85 °C. An LED lamp incorporating the diode is also disclosed.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		

INTERNATIONAL SEARCH REPORT

national Application No

PCT/US 98/17849

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01L33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 622 858 A (NICHIA KAGAKU KOGYO KK) 2 November 1994 cited in the application see page 6, line 4-47 see page 9, line 20-37 see page 17, line 8-10 ---	1-17
A	WO 96 24167 A (ADVANCED TECH MATERIALS ; REDWING JOAN (US); TISCHLER MICHAEL A (US) 8 August 1996 see page 23, line 1-30 see page 29, line 16-28; figure 7 ---	1-7, 13, 15-17
A	US 5 523 589 A (EDMONO JOHN A ET AL) 4 June 1996 see column 5, line 56-62 see column 7, line 44-52 see column 8, line 23-32 ---	1-3, 7, 8, 13, 17
-/--		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (see specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

8 March 1999

Date of mailing of the international search report

15/03/1999

Name and mailing address of the ISA
European Patent Office, P.O. 5818 Patentlaan 2

Authorized officer

INTERNATIONAL SEARCH REPORT

national Application No
PCT/US 98/17849

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 357 458 A (SHARP KK) 7 March 1990 see column 4, line 65 - column 5, line 44 ---	1-3,5-8, 10
A	EP 0 404 565 A (MITSUBISHI KASEI POLYTEC CO ;MITSUBISHI CHEM INO (JP)) 27 December 1990 -----	1,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 98/17849

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0622858 A	02-11-1994	JP 7221103 A	18-08-1995
		JP 2803742 B	24-09-1998
		JP 6314822 A	08-11-1994
		JP 2748818 B	13-05-1998
		JP 6338632 A	06-12-1994
		JP 2783349 B	06-08-1998
		JP 7045867 A	14-02-1995
		JP 2697572 B	14-01-1998
		JP 7094782 A	07-04-1995
		JP 2770717 B	02-07-1998
		JP 7094783 A	07-04-1995
		JP 2770720 B	02-07-1998
		JP 7106633 A	21-04-1995
		JP 7254733 A	03-10-1995
		US 5563422 A	08-10-1996
		US 5652434 A	29-07-1997
		US 5767581 A	16-06-1998
		CN 1102507 A	10-05-1995
WO 9624167 A	08-08-1996	US 5585648 A	17-12-1996
		US 5661074 A	26-08-1997
US 5523589 A	04-06-1996	AU 3629495 A	09-04-1996
		CA 2200305 A	28-03-1996
		CN 1166890 A	03-12-1997
		EP 0783768 A	16-07-1997
		JP 10506234 T	16-06-1998
		WO 9609653 A	28-03-1996
EP 0357458 A	07-03-1990	JP 2068968 A	08-03-1990
		OE 68910906 O	05-01-1994
		OE 68910906 T	17-03-1994
		US 5113233 A	12-05-1992
		US 5616937 A	01-04-1997
EP 0404565 A	27-12-1990	JP 3024771 A	01-02-1991
		OE 69008931 O	23-06-1994
		OE 69008931 T	08-12-1994
		US 5040044 A	13-08-1991

